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(54) **FACILITATING VEHICLE MERGING UTILIZING ROAD MARKERS**

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CPC B31B 7/00; B60B 7/02; B60C 5/08; B60N 2/504; B60N 2/506; B60N 2/544; B60Q 9/008; B60R 11/00; B60T 13/40; B60T 13/403; B60T 15/36; B60T 8/1831; B61K 9/08; B61L 13/04; B61L 23/005

USPC 340/905, 435, 901–903, 425.5, 436, 340/907, 932, 933, 937, 909–910, 438

See application file for complete search history.

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(Continued)

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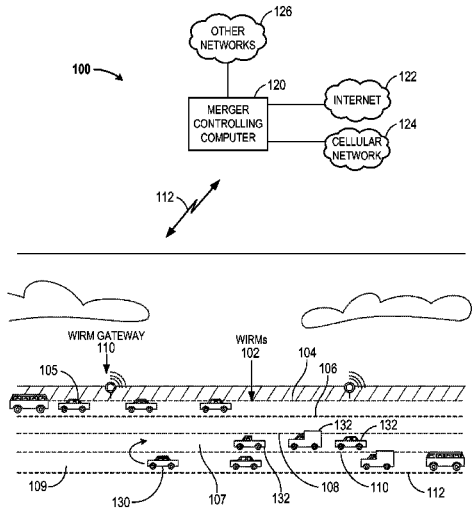
(74) *Attorney, Agent, or Firm* — Blakely Sokoloff Taylor & Zafman

(57) **ABSTRACT**

Disclosed is an apparatus, system, and method to utilize a plurality of road markers to aid a vehicle in merging into a lane. The lane that the merging vehicle desires to merge into is determined. Further, the position of the merging vehicle is determined. Target vehicles are then notified about the merging vehicle utilizing the plurality of road markers.

63 Claims, 4 Drawing Sheets



(51) **Int. Cl.**

G08G 1/095	(2006.01)
G08G 1/01	(2006.01)
G08G 1/02	(2006.01)
G08G 1/04	(2006.01)

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Dragan Samardzija, et al; "Road Nail: Intelligent Road Marking System Testbed", Vehicular Networking Conference (VNC), 2010 IEEE, IEEE, Piscataway, NJ, USA, Dec. 13, 2010, pp. 134-138, XP031857811.

Notification of Transmittal of International Search Report and the Written Opinion of the International Searching Authority in a corresponding PCT Application No. PCT/US2014/015576 dated May 13, 2014.

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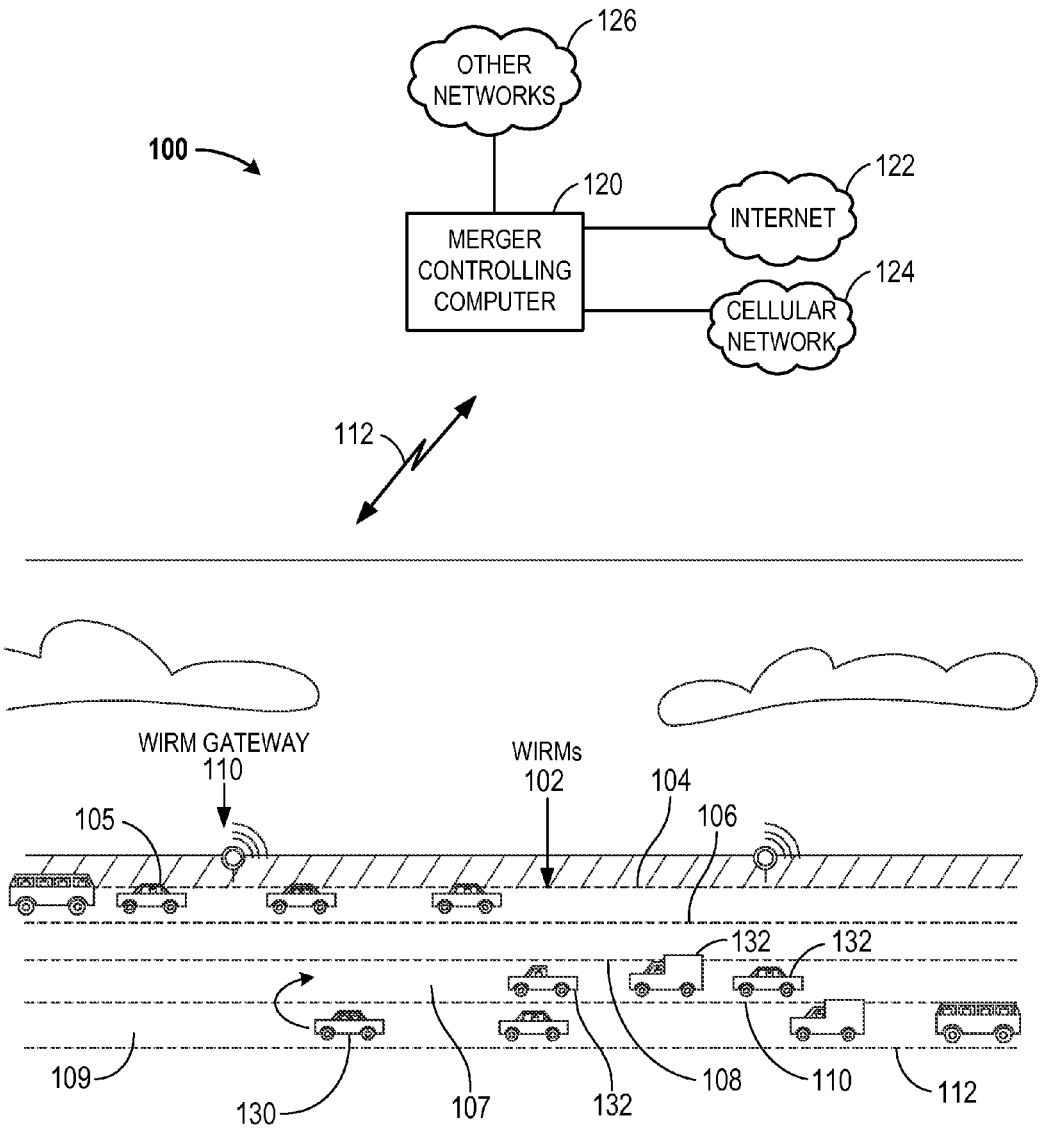
100
OTHER NETWORKS
126
MERGER CONTROLLING COMPUTER
120
INTERNET
122
CELLULAR NETWORK
124
112
WIRM GATEWAY
110
WIRMs
102
104
106
105
132
132
109
130
107
132
108
110
112

FIG. 1

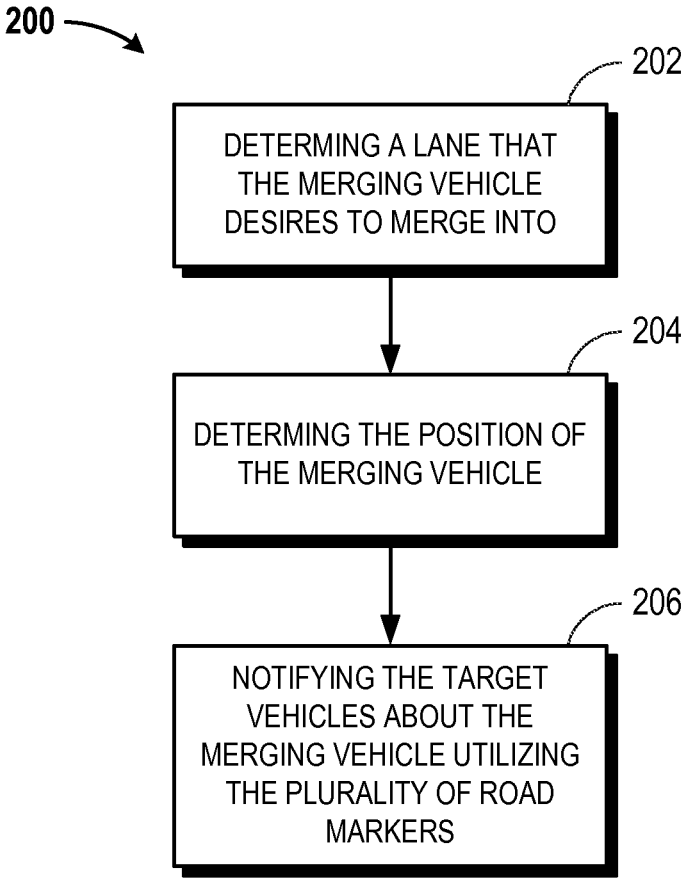
200
202
DETERMING A LANE THAT THE MERGING VEHICLE DESIRES TO MERGE INTO
204
DETERMING THE POSITION OF THE MERGING VEHICLE
206
NOTIFYING THE TARGET VEHICLES ABOUT THE MERGING VEHICLE UTILIZING THE PLURALITY OF ROAD MARKERS

FIG. 2

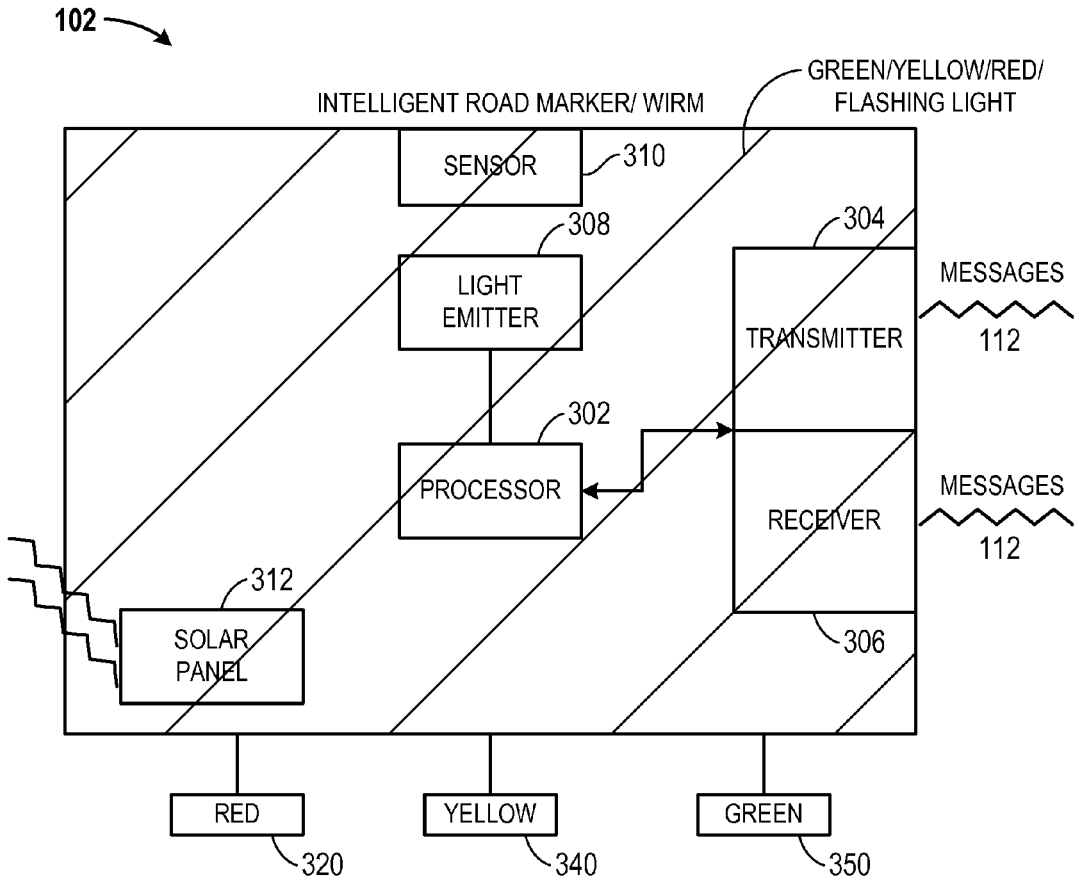
102
INTELLIGENT ROAD MARKER/ WIRM
GREEN/YELLOW/RED/
FLASHING LIGHT
SENSOR
310
308
LIGHT
EMITTER
304
TRANSMITTER
MESSAGES
112
302
PROCESSOR
RECEIVER
MESSAGES
112
312
SOLAR
PANEL
306
RED
320
YELLOW
340
GREEN
350

FIG. 3

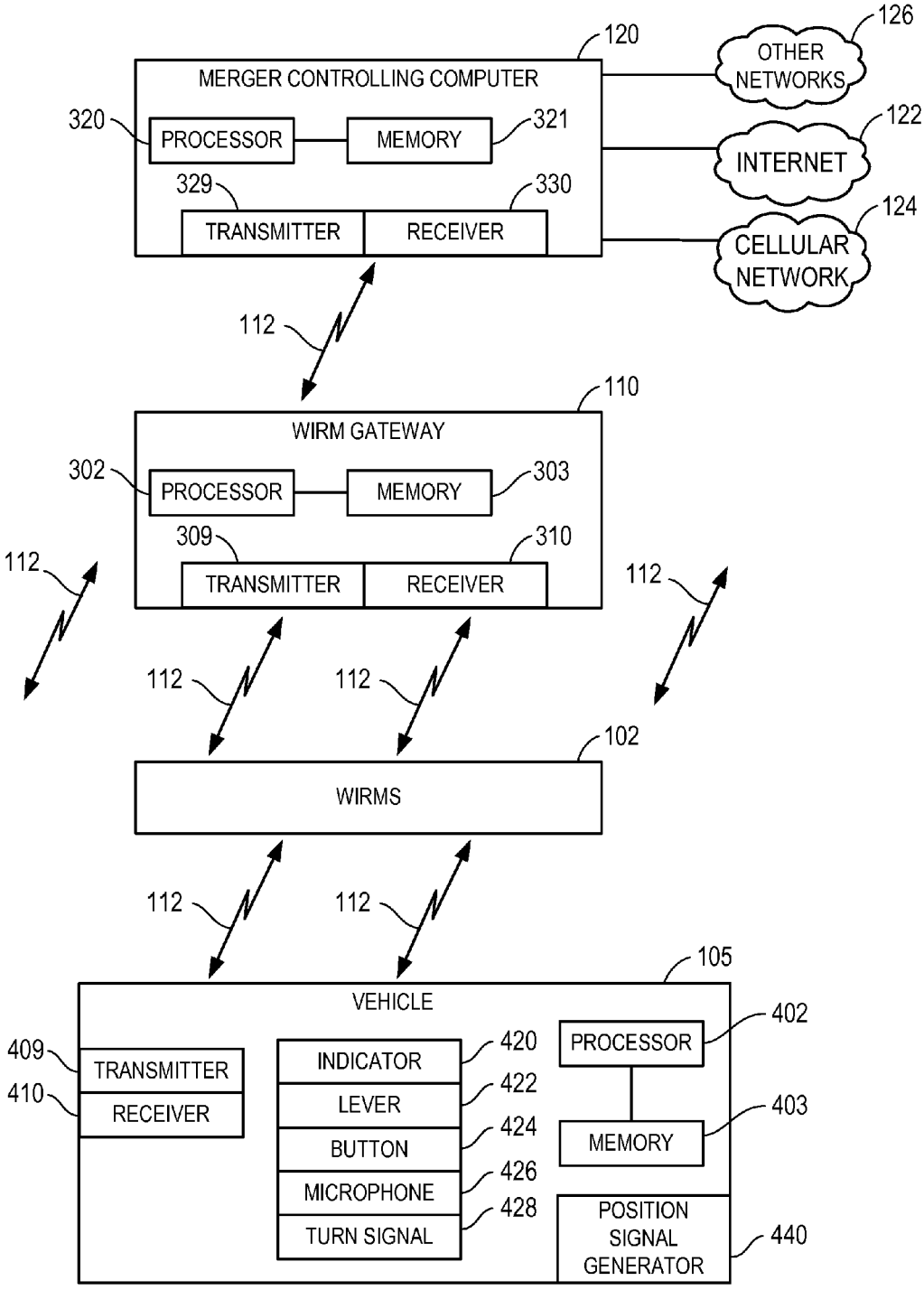
MERGER CONTROLLING COMPUTER
120
PROCESSOR
320
MEMORY
321
TRANSMITTER
329
RECEIVER
330
OTHER NETWORKS
126
INTERNET
122
CELLULAR NETWORK
124
112
WIRM GATEWAY
110
PROCESSOR
302
MEMORY
303
TRANSMITTER
309
RECEIVER
310
WIRMS
102
VEHICLE
105
TRANSMITTER
409
RECEIVER
410
INDICATOR
420
LEVER
422
BUTTON
424
MICROPHONE
426
TURN SIGNAL
428
PROCESSOR
402
MEMORY
403
POSITION SIGNAL GENERATOR
440

FIG. 4

FACILITATING VEHICLE MERGING UTILIZING ROAD MARKERS

BACKGROUND

1. Field

The present invention relates generally to an apparatus, system, and method to facilitate vehicle merging utilizing road markers.

2. Relevant Background

When a vehicle wishes to merge into a lane, particularly in heavy traffic, it is desirable to inform the drivers of vehicles already in the lane such that those drivers can ensure there is sufficient space for the merging vehicle to enter into the lane.

In today's implementations, a driver is expected to command his/her vehicle to flash turn signals shortly before they wish to merge, and drivers of vehicles already in the lane need to be on the lookout for merging vehicles. This unfortunately places a great burden on the drivers of vehicles already in the lane. Moreover, the driver of the merging vehicle is only aware of the traffic conditions in their immediate vicinity and does not have access to information to make optimal decisions about when to safely merge.

At locations where two roads meet, traffic lights can be used to dynamically control traffic merging from one road to the other. Similarly, "Stop" signs, "Yield" signs (called "Give Way" signs in some countries) and roundabouts (sometimes called turning circles) provide static rules for allowing the merging of traffic in and out of lanes.

Unfortunately, these existing mechanisms, such as merely utilizing turn signals and static signs, do not facilitate merging in an efficient and safe manner.

SUMMARY

Embodiments of the invention may relate to an apparatus, system, and method to utilize a plurality of road markers to aid a vehicle in merging into a lane. The lane that the merging vehicle desires to merge into is determined. Further, the position of the merging vehicle is determined. Target vehicles are then notified about the merging vehicle utilizing the plurality of road markers.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram illustrating a system in which embodiments of the invention may be practiced

FIG. **2** is a flow diagram that illustrates a process of notifying target vehicles about a merging vehicle utilizing a plurality of road markers.

FIG. **3** is a diagram of a WIRM.

FIG. **4** is a diagram illustrating components of a merging controlling computer, a WIRM gateway, and a vehicle.

DETAILED DESCRIPTION

The word "exemplary" or "example" is used herein to mean "serving as an example, instance, or illustration." Any embodiment described herein as "exemplary" or "example" is not necessarily to be construed as preferred or advantageous over other embodiments.

With reference to FIG. **1**, FIG. **1** is a diagram illustrating a system in which embodiments of the invention may be practiced. In one embodiment, a vehicle merging system **100** having a plurality of wireless intelligent road markers (WIRMs) **102** in cooperation with a merger controlling computer **120** and WIRM gateways **110** to aid a vehicle in merging into a lane will be hereinafter described. Vehicle merging system **100** utilizing WIRMs **102** may have the ability to: communicate with the merger controlling computer **120**; be aware of the positions and speeds of vehicles **105**; and communicate with vehicles **105**. The vehicle merging system **100** may therefore utilize WIRMs **102** and the merger controlling computer **120**. Also, in some embodiments, WIRM gateways **110** may also be utilized.

In one embodiment, vehicle merging system **100** may implement a method utilizing a plurality of WIRMs **102** and the merger controlling computer **120** to aid a vehicle in merging into a lane. As will be described in more detail, this method may include: determining the lane that a merging vehicle desires to merge into; determining the position of the merging vehicle; and notifying target vehicles about the merging vehicle utilizing the plurality of WIRMs.

As can be seen in FIG. **1**, a highway is illustrated having a plurality of lanes **109** in which a plurality of vehicles **105** (e.g., cars, trucks, etc.) and other vehicles are driving. As a particular example, each of the lanes **109** may have a corresponding group of WIRMs **104**, **106**, **108**, **110**, and **112** that may be utilized to emit lights, flashes, patterns, etc., to warn drivers about vehicles that are about to merge into lanes in front of them, as well as other possible reasons to merge. The WIRMs **102** may communicate messages **112** to the merger controlling computer **120** and with one another. The WIRMs **102** may also utilize WIRM gateways **110** to transmit messages **112** to the merger controlling computer **120**. The merger controlling computer **120** may further be connected to the Internet **122**, a cellular network **124**, as well as other networks **126**.

As one particular example, the vehicle merging system **100** may determine that a vehicle desires to merge into a lane. For example, the vehicle merging system **100** may determine the position of a merging vehicle **130** including the lane **107** that the merging vehicle **130** wants to merge into. As can be seen in FIG. **1**, merging vehicle **130** wants to merge into the lane **107** to its right (e.g., see arrow). The vehicle merging system **100** may identify target vehicles **132** in the adjacent lane that need to be made aware of the merging vehicle **130** and may notify the target vehicles **132** about the merging vehicle **130** by utilizing the plurality of WIRMs **102**. In particular, WIRMs **108** and **110** may be utilized to alert the target vehicles **132** of the merging vehicle's **130** intent to merge into their lane **107** (e.g., by flashing colors). Thus, the vehicle merging system **100** may communicate to the drivers of the target vehicles **132** of the merging vehicle's **130** intent to merge into their lane. In this way, the vehicle merging system **100** may regulate lane changes to optimize traffic flow and safety.

With brief additional reference to FIG. **2**, in one embodiment, a method **200** may be implemented in which a lane that the merging vehicle **130** desires to merge into is determined. (Block **202**). Next, the position of the merging vehicle **130** is determined. (Block **204**). Further, target vehicles **132** are notified about the merging vehicle's **130** intent to merge into their lane by utilizing a plurality of road markers **108** and **110**. (Block **206**).

For example, in one embodiment, determining the lane that the merging vehicle **130** desires to merge into may include the merger controlling computer **120** receiving a message **112** (e.g., a wireless signal) from the merging vehicle **130** indicating the direction in which the merging vehicle **130** intends to merge. Message **112** may come directly from the merging vehicle **130** or from transmissions from the WIRMs **112** and/or the WIRM gateway **110**. Message **112** may be generated based upon a driver actuating an indicator of their

vehicle, such as, a lever or a button. For example, a particular implementation may be the turn lever in the merging vehicle **130** being turned left or right (down/up) by the driver which then turns on the left/right blinker light of the vehicle. This message **112** may be sent as a wireless signal to the merging controlling computer **120** to let the merging controlling computer **120** know that the merging vehicle **130** is planning to merge (e.g., right) into another lane such that the merging controlling computer **120** can notify the target vehicles **132** about the merging vehicle **130** utilizing the WIRMs **108** and **110**. As an example, the message **112** may be a specialized RF signal for the vehicle merging system **100** or a standard cell-phone call signal through a cellular network **124** to the merging controlling computer **120**. It should be appreciated that the turn message **112** from the vehicle **130** may be sent through the WIRMs **102**, the WIRM gateway **110**, and/or through the cellular network **124** to the merging controlling computer **120**.

Further, the position of the merging vehicle **130** may be determined by the merging controlling computer **120** receiving a position message **112** indicating the position of the merging vehicle **130**. This position message **112** may by calculated by the merging vehicle **130** itself (e.g., based upon a GPS position device in the vehicle) or by a position message **112** for the merging vehicle **130** estimated by the WIRMs **110** and **112** and transmitted by the WIRMs and/or the WIRM gateway **110**.

The target vehicles **132** may be notified about the merging vehicle **130** merging into their lane by utilizing the plurality of WIRMs **108** and **110**. For example, WIRMs **108** and **110** may have their presentation changed in front of the target vehicles **132** to provide a visual indication that the merging vehicle **130** is merging lanes. For example, changing the presentation of the WIRMs **108** and **110** may include emitting a light with a particular intensity and with a particular color. In one particular example, WIRMs **108** and **110** may emit a yellow light indicating that a car is about to merge in front of them. Further, the light may be emitted at a particular frequency to provide a strobe pattern to indicate a desirable speed to the drivers of the target vehicles **132**. As an example, WIRMs **108** and **110** may be commanded by the merging controlling computer **120** to emit light at a particular frequency associated with a desired speed so that the WIRMs **108** and **110** emit light in a strobe pattern such that if the target vehicles **132** are traveling at the desired speed, then the strobe pattern appears static to the drivers of the vehicles. In this way, if a target vehicle **132** is traveling at the desired speed, the strobe pattern appears to be static to the driver of the target vehicle. On the other hand, if the target vehicle **132** is traveling above the desired speed, the strobe pattern appears to be coming towards the driver of the vehicle indicating that the target vehicle should slow down. Conversely, if the target vehicle **132** is traveling below the desired speed, the strobe pattern appears to be moving away from the driver of the target vehicle.

With brief additional reference to FIG. **3**, an example of the components of a WIRM **102**, according to one embodiment of the invention, will be described. A WIRM **102** may be used to communicate messages **112** with other WIRMs **102**, WIRM gateways **110**, the merger controlling computer **120**, and to and from vehicles **105**. WIRMs **102** may comprise a light emitter **308** (e.g., an LED) to emit different light colors (e.g. red **320**, yellow **340**, green **350**, etc.) at particular frequencies; a transmitter **304** to transmit messages **112**; a receiver **304** to receive messages **112**; and a processor **302**. Processor **302** may be used to: command the light emitter **308** to emit a light at a particular frequency and in a particular color based upon a received message **112** (e.g., from the merger controlling computer **120**); and to command the transmitter **304** to transmit messages **112** to other WIRMs, WIRM gateway **110**, and to the merger controlling computer **120**.

WIRMs **102** may include a sensor **310** to estimate the lane of adjacent vehicles, the speed of adjacent vehicles, and the position/location of adjacent vehicles. Sensor **310** may be an optical or a motion vibration sensor to determine the speed and position of the merging vehicles **130** and/or target vehicles **132**. Processor **302** may command transmitter **304** to transmit the position and speed messages **112** of the merging vehicle **130** and target vehicles **132** to other WIRMs **102**, as well as, through WIRM gateway **110** to the merger controlling computer **120** or directly to the merging controlling computer **120**. For example, a WIRM transmitter **302** may transmit a message **112** to the merger controlling computer **120** indicating a lane the merging vehicle desires to move into as well as the position and speed of the merging vehicle. The WIRM receiver **306** may receive a message **112** from merger controlling computer **120** indicating a color and frequency at which to flash to notify target vehicles about a merging vehicle. The WIRM **102** under control of processor **302** may flash at the designated color and frequency. For example, particular WIRMs associated with particular lanes may receive messages from the merger controlling computer **120** to flash based upon the positions and speeds of the merging vehicle **130** and the target vehicles **132**. Additionally, WIRMs **102** may include a solar panel **312** in order to provide power to the WIRM.

With brief additional reference to FIG. **4**, an example of the components of the merging controlling computer **120**, the WIRM gateway **110**, and a vehicle **105** that may be utilized by the vehicle merging system **100**, according to one embodiment of the invention, will be described. For example, WIRM gateway **110** may include a processor **302**, a memory **303**, a transmitter **309**, and a receiver **310** to implement particular functions. Transmitter **309** may transmit messages **112** to WIRMs **102**, vehicles **105**, and to merger controlling computer **120** and likewise may receive messages **112** via receiver **310** from WIRMs **102**, vehicles **105** and from the merging controlling computer **120**.

Similarly, merger controlling computer **120** may include a processor **320**, a memory **321**, as well as an interface (e.g., transmitter **329** and receiver **330**) to implement particular functions. Merger controlling computer **120** may be connected to the Internet **122**, cellular networks **124**, and other networks **126**. Merger controlling computer **120** may receive messages **112** from WIRM gateway **110**, and/or WIRMs **102**, and/or directly from vehicles **105**, as previously described. Likewise, merger controlling computer **120** may transmit messages **112** to WIRM gateway **110** (such that WIRM gateway **110** can pass on messages to WIRMs **102**), and/or directly to WIRMs **102**, and/or directly to vehicles **105**. As previously described, these types of messages **112** from the merging controlling computer **120** may be to WIRMs **102** to notify target vehicles about merging vehicles utilizing the WIRMs **102** to provide visual indications, such as, flashing lights in particular colors and at particular frequencies to notify the target vehicles about the merging vehicle.

Further, vehicles **105** may include components such as a processor **402** and a memory **403** to implement various functions. A vehicle may also include a transmitter **409** and a receiver **410** to transmit and receive messages **112** from the WIRMs **102**, WIRM gateway **110**, and merging controlling computer **120**. Additionally components of vehicle **400** may include an indicator **420**, such as: a turn lever **422** to specify turning left or right; a turning button **424** to specify turning

left or right; a microphone **426** to receive a sound from the driver to specify turning left or right; as well as a turn signal light **428** that flashes to let target vehicles know whether the vehicle is turning left or right. Further, the vehicle **105** may include a position signal generator **440** that utilizes GPS software to determine the position of the vehicle. The position signal generator **440** may determine the position of the vehicle that is transmitted as a message **112** via transmitter **409** to WIRMs **102**, WIRM gateway **110** and/or to merging controlling computer **120**.

A particular implementation of the vehicle merging system **100** will be hereinafter described.

As an example, with reference to FIG. **1** and the other figures, the vehicle merging system **100** may determine that a merging vehicle **130** desires to move (e.g., right—see arrow) into another lane **107**. The vehicle merging system **100** may determine the position of the merging vehicle **130** and the lane that the merging vehicle **130** wants to merge into. Further, the vehicle merging system **100** may identify target vehicles **132** that should be made aware of the merging vehicle **130** and may notify the target vehicles **132** about the merging vehicle **130** by utilizing a plurality of WIRMs **108** and **110**. As an example, WIRMs **108** and **110** may be commanded by the merger controlling computer **120** to flash with a particular color and at a particular frequency such that the target vehicles **132** are notified to slow down and to allow the merging of the merging vehicle **130**. In this way, the vehicle merging system **100** may regulate lane changes to optimize traffic flow and to optimize safety.

In one embodiment, determining the lane that the merging vehicle **130** desires to merge into includes the merging controlling computer **120** receiving a message **112** from the merging vehicle **130** indicating the direction in which the merging vehicle **130** is merging. This message **112** may be generated based upon a driver actuating an indicator **420** of the vehicle such as a turn lever **422** or a turn button **422**. As an example, a driver may turn the turn lever **422** in the vehicle (down/up or left/right) which turns on the left/right blinker light on the vehicle. The turn message **112** may be sent as a specific RF signal to the merging controlling computer **120** to let the merging controlling computer **120** know that the merging vehicle **130** is planning to merge into another lane **109** such that the merging controlling computer **120** can transmit a flashing message **112** to the WIRMs **108** and **110** to notify the target vehicles **132** about the merging vehicle **130**. In one embodiment, the merging controlling computer **120** may command that the WIRMs **108** and **110** flash a particular color at a particular frequency to notify the target vehicles **132** about the merging vehicle **130** and specify a safe speed for them to allow the merging of the merging vehicle **130**.

The RF signal for the merging message **112** indicating the merging may be a specialized signal for the vehicle merging system **100** transmitted by the WIRMs **102**, the WIRM gateway **110**, or from the vehicle itself. Also, a standard cellphone call from the merging vehicle **130** (e.g., via transmitter **409**) may transmit the merging message **112** through a cellular network **124** to the merging controlling computer **120**. This may be a specialized component of the vehicle or a typical wireless device.

Further, as one example, WIRMs **110** and **112** adjacent to the merging vehicle **130** via sensor **310** may identify the turn signal of the merging vehicle **130** and may transmit the merging message **112** to the merging controlling computer **120** instead of or in addition to the merging vehicle **130** itself.

As another example, instead of or in addition to a physical actuator (e.g., a turn lever **422** or turn button **424**), a microphone **426** of the merging vehicle **130** may receive a sound from the driver (e.g., "I am merging right") which may be used to generate the merging message **112** that is transmitted to the merger controlling computer **120** to indicate that merging vehicle **130** is planning to merge lanes. Additionally, the WIRMs **110** and **112** may themselves, based upon sensors **310**, determine that the vehicle is merging to the right (e.g. based on the movement of the vehicle) and may transmit the merging message **112** to the merger controlling computer **120**.

In another embodiment, in determining a lane that the merging vehicle should merge into, the merger controlling computer **120** may determine the lane based upon the physical characteristics of the lane. For example, this may include determining that the merging vehicle is coming down an on-ramp onto a freeway, or where the lane ends shortly, or where heavy traffic is ahead, or where an accident is ahead, or where road work is ahead, etc. Based upon this, the merger controlling computer **120** may automatically transmit flash messages **112** to the WIRMs of the lane of interest to flash lights to indicate to vehicles in the lane that there is a reason to merge to the left or the right to another lane due to an upcoming event.

Further, as previously described, determining the position of the merging vehicle **130** may include the merger controlling computer **120** receiving a position message **112** indicating the position of the merging vehicle **130**. This position message **112** may come from a position signal generator **440** of the merging vehicle **130** itself (e.g., based upon a GPS position device in the vehicle) or the position message **112** for the merging vehicle **130** may be generated by the WIRMs **110** and **112** based upon utilization of their sensors **310**, as previously described. Further, as previously described, the position message **112** from the merging vehicle **130** itself may be transmitted through the WIRMs **102** and/or the WIRM gateway **110** to the merger controlling computer **120** or via a wireless link through a cellular network **124** to the merger controlling computer **120**.

Further, in one embodiment, notifying the target vehicles **132** about the merging vehicle **130** utilizing the plurality WIRMs **108** and **110** may include changing the presentation of the WIRMs **108** and **110** in front of the target vehicles **132** to provide a visual indication that the merging vehicle **130** is merging lanes. This may be based upon a flash signal **112** transmitted by the merger controlling computer **120**, as previously described. For example, changing the presentation of the WIRMs **108** and **110** may include emitting a light from the light emitter **308** at a particular frequency and in a particular color (e.g., yellow). Further, emitting the light at the particular frequency may further indicate a desirable speed to the drivers of the target vehicles **132**. In particular, the lights may be emitted at a particular frequency to generate a strobe pattern to indicate to the drivers of the target vehicles a safe speed to allow the merging vehicle **130** to merge safely.

Additionally, in one embodiment, the target vehicles **132** may be notified about the merging vehicle **130** by the merging controlling computer **120** transmitting a notification message **112** to the target vehicles **132** themselves notifying the target vehicles about the merging vehicle. For example, the notification message **112** may be an audio signal that is transmitted to the speaker of the target vehicle **132** or a visual communication. As a particular example, the notification message **112** may be a voice message to the target vehicle **132** telling the driver that the vehicle to the left or right of them is about to merge. The notification may also be a visual indication on a screen of driver's vehicle, such as a display screen showing vehicles on the freeway lanes around the driver's vehicles, and, in particular, providing a flashing indication of the merg-

ing vehicle **130** that is about to merge. It should be appreciated that these notification messages **112** may be transmitted based upon wireless signals from the merger controlling computer **120** and/or from the WIRM gateway **110** and/or from the WIRMs **102**. Additionally, the merger controlling computer **120** may notify the target vehicles **132** and the merging vehicle **130** with such notification messages **112** via a cellular network **124** and/or through the Internet **122**.

As an additional embodiment, the presentation of the WIRMs **110** and **112** in front of the merging vehicle may be changed to provide a visual indication that it is safe or not same for the merging vehicle **130** to merge lanes. This may be based upon a flash signal **112** transmitted by the merger controlling computer **120**, as previously described. Presentation of the WIRMs **110** and **112** in front of the merging vehicle **130** may include emitting a light at a particular frequency and in a particular color. For example, the WIRMs **110** and **112** may display a green color (indicating it is safe to merge) at a particular frequency to indicate a desirable speed to the driver of the merging vehicle **130** such that the merging vehicle maintains a suitable speed and is provided authorization to merge. However, as another example, the WIRMs **110** and **112** in front of the merging vehicle **130** may be changed to provide an indication that it is not safe for the merging vehicle **130** to merge lanes, such as by flashing red lights.

As yet another example, the merging vehicle **130** may be an automated vehicle in which the driver does not control speed, steering, or merging of the vehicle. In this example, determining the lane that the merging vehicle **130** desires to merge into may further include the merger controlling computer **120** receiving a message **112** from the automated merging vehicle indicating the direction that the merging vehicle **130** would like to merge into—in which driver input is not utilized. Therefore, the merger message **112** generated by the automated vehicle may indicate that it is an automated vehicle and may further indicate the particular direction in which the automated vehicle desires to merge lanes.

In a further implementation, the merger controlling computer **120** may track and store the amount of lanes merged into and out of by vehicles. For example, a vehicle may be weaving into and out of lanes very often, abusing the system, and obstructing traffic flow. This is disadvantageous for other drivers. In this implementation, the merger controlling computer **120** can notify the merging vehicle to stop changing lanes so often. Additionally, in certain fee-based systems, the merging vehicle that is weaving into and out of lanes to often can be charged extra fees.

It should be appreciated that the various described implementations of the invention utilizing WIRMs **102**, the WIRM gateway **110**, and the merger controlling computer **120** are just various examples of implementations. For example, in one implementation WIRM gateways **110** are not utilized at all and only the WIRMs **102** and the merger controlling computer **120** are utilized. In another implementation, the merging controlling computer **120** and the WIRM gateways **110** may not be utilized at all. In this implementation, the WIRMs **102** themselves will determine the lane that the merging vehicle **130** desires to merge into; determine the position of the merging vehicle **130**; and notify the target vehicles **132** about the merging vehicle **130** by flashing particular colors, at particular frequencies, to let the target vehicles **132** know about the merging vehicle **130** and a proper safe speed to be at. As another example of possible implementations, the WIRMs **102** may not utilize wireless communications, but may be wired to one another, and to the WIRM gateways **110**, in order to wirelessly communicate with the merger controlling computer **120**.

It should be appreciated that embodiments of the invention previously described may be implemented in conjunction with the execution of instructions (e.g. stored in memories) by the processors (e.g., the processors of the WIRMs **102**, WIRM gateways **110**, and the merger controlling computer **120**) and/or other circuitry and/or other devices. Particularly, this circuitry including but not limited to processors, may operate under the control of a program, routine, or the execution of instructions to execute methods or processes in accordance with embodiments of the invention. For example, such a program may be implemented in firmware or software (e.g., stored in memory and/or other locations) and may be implemented by processors and/or other circuitry. Further, it should be appreciated that the terms processor, microprocessor, circuitry, controller, etc., refer to any type of logic or circuitry capable of executing logic, commands, instructions, software, firmware, functionality, etc. Further, the WIRMs **102**, WIRM gateways **110**, and the merger controlling computer **120** may communicate via one or more communication links that are based on or otherwise supported by any suitable wireless communication technology or any suitable type of wired technology.

It should be appreciated that when the devices are mobile or wireless devices that they may communicate via one or more wireless communication links through a wireless network that are based on or otherwise support any suitable wireless communication technology. For example, in some aspects the wireless device and the other devices may associate with a network including a wireless network. In some aspects the network may comprise a body area network or a personal area network (e.g., an ultra-wideband network). In some aspects the network may comprise a local area network or a wide area network. A wireless device may support or otherwise use one or more of a variety of wireless communication technologies, protocols, or standards such as, for example, CDMA, TDMA, OFDM, OFDMA, WiMAX, and Wi-Fi. Similarly, a wireless device may support or otherwise use one or more of a variety of corresponding modulation or multiplexing schemes. A wireless device may thus include appropriate components (e.g., air interfaces) to establish and communicate via one or more wireless communication links using the above or other wireless communication technologies. For example, a device may comprise a wireless transceiver with associated transmitter and receiver components (e.g., a transmitter and a receiver) that may include various components (e.g., signal generators and signal processors) that facilitate communication over a wireless medium. As is well known, a mobile wireless device may therefore wirelessly communicate with other mobile devices, cell phones, other wired and wireless computers, Internet web-sites, etc.

The techniques described herein can be used for various wireless communication systems such as Code Division Multiple Access (CDMA), Time division multiple access (TDMA), Frequency Division Multiple Access (FDMA), Orthogonal Frequency-Division Multiple Access (OFDMA), Single Carrier FDMA (SC-FDMA) and other systems. The terms "system" and "network" are often used interchangeably. A CDMA system can implement a radio technology such as Universal Terrestrial Radio Access (UTRA), CDMA2000, etc. UTRA includes Wideband-CDMA (W-CDMA) and other variants of CDMA. CDMA2000 covers Interim Standard (IS)-2000, IS-95 and IS-856 standards. A TDMA system can implement a radio technology such as Global System for Mobile Communications (GSM). An OFDMA system can implement a radio technology such as Evolved Universal Terrestrial Radio Access; (Evolved UTRA or E-UTRA), Ultra Mobile Broadband (UMB), Institute of

Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, Flash-OFDM®, etc. Universal Terrestrial Radio Access (UTRA) and E-UTRA are part of Universal Mobile Telecommunication System (UMTS). 3GPP Long Term Evolution (LTE) is an upcoming release of UMTS that uses E-UTRA, which employs OFDMA on the downlink and SC-FDMA on the uplink. UTRA, E-UTRA, UMTS, LTE and GSM are described in documents from an organization named "3rd Generation Partnership Project" (3GPP). CDMA2000 and UMB are described in documents from an organization named "3rd Generation Partnership Project 2" (3GPP2).

The teachings herein may be incorporated into (e.g., implemented within or performed by) a variety of apparatuses (e.g., devices). For example, one or more aspects taught herein may be incorporated into a phone (e.g., a cellular phone), a personal data assistant ("PDA"), a tablet, a mobile computer, a laptop computer, a tablet, an entertainment device (e.g., a music or video device), a headset (e.g., headphones, an earpiece, etc.), a user I/O device, a computer, a wired computer, a fixed computer, a desktop computer, a server, a point-of-sale device, an entertainment device, a set-top box, or any other suitable device. These devices may have different power and data requirements.

In some aspects a wireless device may comprise an access device (e.g., a Wi-Fi access point) for a communication system. Such an access device may provide, for example, connectivity to another network (e.g., a wide area network such as the Internet or a cellular network) via a wired or wireless communication link. Accordingly, the access device may enable another device (e.g., a Wi-Fi station) to access the other network or some other functionality.

Those of skill in the art would understand that information and signals may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the above description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

Those of skill would further appreciate that the various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the embodiments disclosed herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present invention.

The various illustrative logical blocks, modules, and circuits described in connection with the embodiments disclosed herein may be implemented or performed with a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

The steps of a method or algorithm described in connection with the embodiments disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module may reside in RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, hard disk, a removable disk, a CD-ROM, or any other form of storage medium known in the art. An exemplary storage medium is coupled to the processor such the processor can read information from, and write information to, the storage medium. In the alternative, the storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in a user terminal. In the alternative, the processor and the storage medium may reside as discrete components in a user terminal.

In one or more exemplary embodiments, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software as a computer program product, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Computer-readable media includes both computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A storage media may be any available media that can be accessed by a computer. By way of example, and not limitation, such computer-readable media can comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that can be used to carry or store desired program code in the form of instructions or data structures and that can be accessed by a computer. Also, any connection is properly termed a computer-readable medium. For example, if the software is transmitted from a web site, server, or other remote source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of medium. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

The previous description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the present invention. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without departing from the spirit or scope of the invention. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

What is claimed is:

1. A method of utilizing a plurality of road markers to aid a vehicle in merging into a lane comprising:

determining the lane that the merging vehicle desires to merge into;

determining a position of the merging vehicle; and

notifying target vehicles about the merging vehicle utilizing the plurality of road markers, the notifying further comprising transmitting commands to the plurality of road markers.

2. The method of claim **1**, wherein determining the lane that the merging vehicle desires to merge into further comprises receiving a message from the merging vehicle indicating the direction in which the merging vehicle is merging.

3. The method of claim **2**, wherein the message from the merging vehicle indicating the direction in which the merging vehicle is merging is generated based upon a driver actuating an indicator.

4. The method of claim **3**, wherein the indicator is at least one of a lever, a button, or a microphone to receive a sound.

5. The method of claim **1**, wherein determining the lane that the merging vehicle desires to merge into further comprises determining the lane based upon the physical characteristics of the lane.

6. The method of claim **1**, wherein determining the position of the merging vehicle further comprises receiving a position message indicating the position of the merging vehicle.

7. The method claim **1**, wherein notifying the target vehicles about the merging vehicle utilizing the plurality of road markers further comprises changing the presentation of the road markers in front of the target vehicles to provide a visual indication that the merging vehicle is merging lanes.

8. The method claim **7**, wherein changing the presentation of the road markers includes emitting a light at a particular frequency and in a particular color.

9. The method claim **8**, wherein emitting the light at the particular frequency further indicates a desirable speed to the drivers of the target vehicles.

10. The method claim **1**, further comprising changing the presentation of the road markers in front of the merging vehicle to provide a visual indication that it is safe for the merging vehicle to merge lanes.

11. The method claim **10**, wherein changing the presentation of the road markers includes emitting a light at a particular frequency and in a particular color.

12. The method claim **11**, wherein emitting the light at the particular frequency further indicates a desirable speed to the driver of the merging vehicle.

13. The method claim **10**, further comprising changing the presentation of the road markers in front of the merging vehicle to provide a visual indication that it is not safe for the merging vehicle to merge lanes.

14. The method claim **1**, wherein notifying the target vehicles about the merging vehicle further comprises commanding a wireless communication to the target vehicles notifying the target vehicles about the merging vehicle.

15. The method claim **14**, wherein the notification is at least one of an audio or visual communication.

16. The method claim **1**, wherein determining the lane that merging vehicle desires to merge into further comprises receiving a message from the merging vehicle indicating the direction in which the merging vehicle is merging in which the merging vehicle is an automated vehicle and driver input is not utilized.

17. The method claim **1**, wherein a merger controlling computer tracks and stores an amount of lane merges by vehicles.

18. A merger controlling computer to command a plurality of road markers to aid a vehicle in merging into a lane comprising:

an interface; and

a processor to control operations including:

determining the lane that the merging vehicle desires to merge into;

determining a position of the merging vehicle; and

transmitting commands through the interface to the plurality of road markers to notify target vehicles about the merging vehicle.

19. The merger controlling computer of claim **18**, wherein determining the lane that the merging vehicle desires to merge into further comprises receiving a message from the merging vehicle indicating the direction in which the merging vehicle is merging.

20. The merger controlling computer of claim **19**, wherein the message from the merging vehicle indicating the direction in which the merging vehicle is merging is generated based upon a driver actuating an indicator.

21. The merger controlling computer of claim **20**, wherein the indicator is at least one of a lever, a button, or a microphone to receive a sound.

22. The merger controlling computer of claim **18**, wherein determining the lane that the merging vehicle desires to merge into further comprises determining the lane based upon the physical characteristics of the lane.

23. The merger controlling computer of claim **18**, wherein determining the position of the merging vehicle further comprises receiving a position message indicating the position of the merging vehicle.

24. The merger controlling computer of claim **18**, wherein notifying the target vehicles about the merging vehicle further comprises transmitting commands to the road markers in front of the target vehicles to provide a visual indication that the merging vehicle is merging lanes.

25. The merger controlling computer of claim **24**, wherein commanding the road markers in front of the target vehicles to provide a visual indication further comprises commanding the road markers to emit a light at a particular frequency and in a particular color.

26. The merger controlling computer of claim **25**, wherein emitting the light at the particular frequency further indicates a desirable speed to the drivers of the target vehicles.

27. The merger controlling computer of claim **18**, further comprising transmitting commands to the road markers in front of the merging vehicle to provide a visual indication that it is safe for the merging vehicle to merge lanes.

28. The merger controlling computer of claim **27**, wherein providing the visual indication that it is safe for the merging vehicle to merge lanes includes commanding the road markers in front of the merging vehicle to emit a light at a particular frequency and in a particular color.

29. The merger controlling computer of claim **18**, further comprising transmitting commands to the plurality of road markers in front of the merging vehicle to provide a visual indication that it is not safe for the merging vehicle to merge lanes.

30. The merger controlling computer of claim **18**, wherein notifying the target vehicles about the merging vehicle further comprises commanding a wireless communication to the target vehicles notifying the target vehicles about the merging vehicle.

31. The merger controlling computer of claim **30**, wherein the notification is at least one of an audio or visual communication.

32. The merger controlling computer of claim **18**, wherein determining the lane that merging vehicle desires to merge into further comprises receiving a message from the merging vehicle indicating the direction in which the merging vehicle is merging in which the merging vehicle is an automated vehicle and driver input is not utilized.

33. The merger controlling computer of claim 18, wherein the merger controlling computer further tracks and stores an amount of lane merges by vehicles.

34. A merger controlling computer to command a plurality of road markers to aid a vehicle in merging into a lane comprising:

means for determining the lane that the merging vehicle desires to merge into;

means for determining a position of the merging vehicle; and

means for notifying target vehicles about the merging vehicle utilizing the plurality of road markers, the means for notifying further comprising means for transmitting commands to the plurality of road markers.

35. The merger controlling computer of claim 34, wherein determining the lane that the merging vehicle desires to merge into further comprises means for receiving a message from the merging vehicle indicating the direction in which the merging vehicle is merging.

36. The merger controlling computer of claim 35, wherein the message from the merging vehicle indicating the direction in which the merging vehicle is merging is generated based upon a driver actuating an indicator.

37. The merger controlling computer of claim 36, wherein the indicator is at least one of a lever, a button, or a microphone to receive a sound.

38. The merger controlling computer of claim 34, wherein determining the lane that the merging vehicle desires to merge into further comprises means for determining the lane based upon the physical characteristics of the lane.

39. The merger controlling computer of claim 34, wherein determining the position of the merging vehicle further comprises means for receiving a position message indicating the position of the merging vehicle.

40. The merger controlling computer of claim 34, wherein notifying the target vehicles about the merging vehicle utilizing the plurality of road markers further comprises means for changing the presentation of the road markers in front of the target vehicles to provide a visual indication that the merging vehicle is merging lanes.

41. The merger controlling computer of claim 40, wherein changing the presentation of the road markers includes emitting a light at a particular frequency and in a particular color.

42. The merger controlling computer of claim 41, wherein emitting the light at the particular frequency further indicates a desirable speed to the drivers of the target vehicles.

43. The merger controlling computer of claim 34, further comprising means for changing the presentation of the road markers in front of the merging vehicle to provide a visual indication that it is safe for the merging vehicle to merge lanes.

44. The merger controlling computer of claim 43, wherein changing the presentation of the road markers includes emitting a light at a particular frequency and in a particular color.

45. The merger controlling computer of claim 44, wherein emitting the light at the particular frequency further indicates a desirable speed to the driver of the merging vehicle.

46. The merger controlling computer of claim 34, further comprising means for changing the presentation of the road markers in front of the merging vehicle to provide a visual indication that it is not safe for the merging vehicle to merge lanes.

47. The merger controlling computer of claim 34, wherein notifying the target vehicles about the merging vehicle further comprises means for commanding a wireless communication to the target vehicles notifying the target vehicles about the merging vehicle.

48. The merger controlling computer of claim 47, wherein the notification is at least one of an audio or visual communication.

49. A computer program product comprising:

a computer-readable medium comprising code for:

determining a lane that a merging vehicle desires to merge into;

determining a position of the merging vehicle; and

notifying target vehicles about the merging vehicle utilizing a plurality of road markers, the notifying further comprising transmitting commands to the plurality of road markers.

50. The computer program product of claim 49, wherein determining the lane that the merging vehicle desires to merge into further comprises code for receiving a message from the merging vehicle indicating the direction in which the merging vehicle is merging.

51. The computer program product of claim 50, wherein the message from the merging vehicle indicating the direction in which the merging vehicle is merging is generated based upon a driver actuating an indicator.

52. The computer program product of claim 51, wherein the indicator is at least one of a lever, a button, or a microphone to receive a sound.

53. The computer program product of claim 49, wherein determining the lane that the merging vehicle desires to merge into further comprises code for determining the lane based upon the physical characteristics of the lane.

54. The computer program product of claim 49, wherein determining the position of the merging vehicle further comprises code for receiving a position message indicating the position of the merging vehicle.

55. The computer program product of claim 49, wherein notifying the target vehicles about the merging vehicle utilizing the plurality of road markers further comprises code for changing the presentation of the road markers in front of the target vehicles to provide a visual indication that the merging vehicle is merging lanes.

56. The computer program product of claim 55, wherein changing the presentation of the road markers includes emitting a light at a particular frequency and in a particular color.

57. The computer program product of claim 56, wherein emitting the light at the particular frequency further indicates a desirable speed to the drivers of the target vehicles.

58. The computer program product of claim 49, further comprising code for changing the presentation of the road markers in front of the merging vehicle to provide a visual indication that it is safe for the merging vehicle to merge lanes.

59. The computer program product of claim 58, wherein changing the presentation of the road markers includes emitting a light at a particular frequency and in a particular color.

60. The computer program product of claim 59, wherein emitting the light at the particular frequency further indicates a desirable speed to the driver of the merging vehicle.

61. The computer program product of claim 49, further comprising code for changing the presentation of the road markers in front of the merging vehicle to provide a visual indication that it is not safe for the merging vehicle to merge lanes.

62. The computer program product of claim 49, wherein notifying the target vehicles about the merging vehicle further comprises code for commanding a wireless communication to the target vehicles notifying the target vehicles about the merging vehicle.

63. The computer program product of claim 62, wherein the notification is at least one of an audio or visual communication.

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